

Flexible Agent-based Communications for Exploration, Phase I

Completed Technology Project (2018 - 2019)



Project Introduction

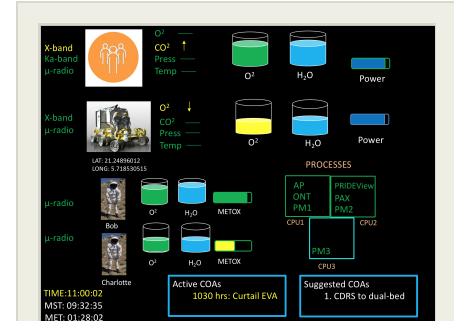
Because close collaboration between the crew and mission control will not be practical for inter-planetary exploration, NASA envisions the need for an intelligent autonomous agent that can continually integrate data from the spacecraft or lunar/planetary base to advise the crew during their mission. TRAC Labs has designed and prototyped such an agent called a cognitive architecture for space exploration (CASE) that incorporates a procedure development system known as PRIDE that allows for variably autonomous execution of both crew and robotic procedures, an automated planner that plans and re-plans the execution of procedures to achieve overall mission goals, an ontology data management system that makes system states available to all the components, a process manager to manage the use of distributed computing resources that support the CASE components, and a natural language dialog system to allow the crew access to any part of the architecture.

However, past and current work in NASA space analogs, such as NEEMO and HERA has shown that the usefulness of any automation supporting human activity is only as good as its user interfaces and interaction. The agent must have a suite displays and interaction modes that can update the users' situation awareness and recommend courses of action without undue cognitive load on the users, particularly the intra-vehicular activity user, or IVA. Therefore, this proposal seeks to investigate, design and test a canonical interaction protocol for CASE, called a flexible agent-based communication for exploration (FACE) that will include natural language dialog and active graphics, provide a consistent presentation of the current situation to the IVA, rapidly assess anomalous situations so as to focus the users' attention on the key facts of the situation, recommend courses of action for correcting anomalous situations and provide for variable autonomy and user override of any autonomous operation.

Anticipated Benefits

After Phase II, the FACE protocols and software components will be available for exploration systems development and testing. Any program using intelligent agency can use FACE, e.g.,

- Lunar base management
- Mars base management
- Deep Space Gateway (and DST)
- NASA Analogs: HERA, iPAS ground test facility



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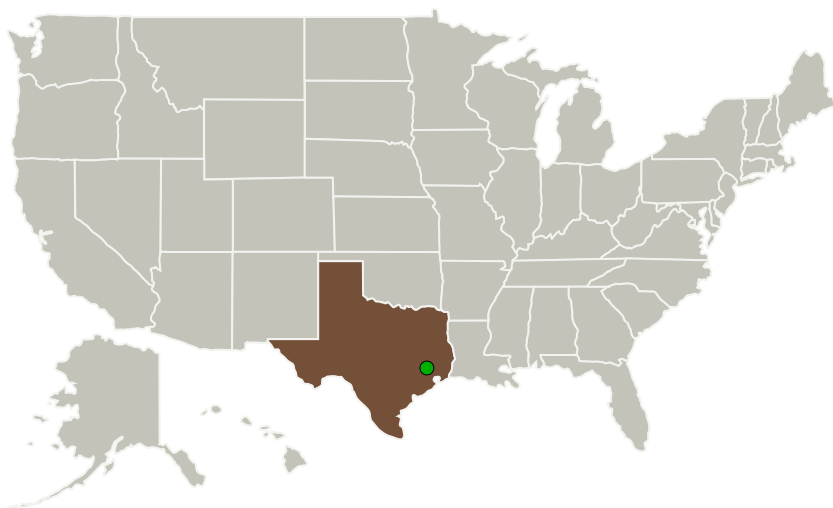
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TRAC Labs sells PRIDE to oil field services company, Baker Hughes, which has already expressed interest in licensing some of the new capabilities being developed in this project, e.g., the Top Level Display (TLD). Other non-NASA applications with a PRIDE base include:

- Commercial space: Sierra Nevada Corporation (Dream Chaser program uses PRIDE), as well as ABL Space and Stratolaunch
- DoD: Brigade and Division military command groups, Naval aircraft carriers

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
TRAC Labs, Inc.	Lead Organization	Industry	Webster, Texas
 Johnson Space Center (JSC)	Supporting Organization	NASA Center	Houston, Texas

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

TRAC Labs, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

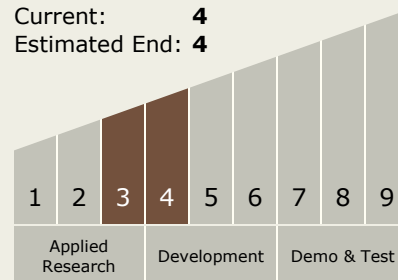
Carlos Torrez

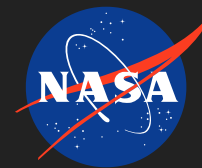
Principal Investigator:

Russell Bonasso

Technology Maturity (TRL)

Start: 3
Current: 4
Estimated End: 4





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Primary U.S. Work Locations

Texas

Project Transitions



July 2018: Project Start

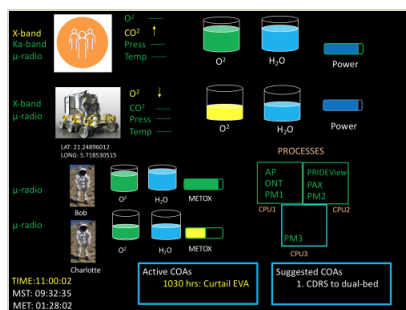


February 2019: Closed out

Closeout Documentation:

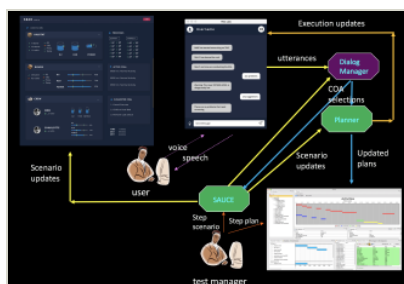
- Final Summary Chart(<https://techport.nasa.gov/file/141343>)

Images



Briefing Chart Image

Flexible Agent-based
Communications for Exploration,
Phase I
(<https://techport.nasa.gov/image/129910>)



Final Summary Chart Image

Flexible Agent-based
Communications for Exploration,
Phase I
(<https://techport.nasa.gov/image/129746>)

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - └ TX06.2 Extravehicular Activity Systems
 - └ TX06.2.3 Informatics and Decision Support Systems

Target Destinations

The Moon, Mars